
Geological Sciences

Jeffrey D. Keith, Chair
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College of Physical and Mathematical Sciences Advisement
Center
N-179 ESC, (801) 422-6270

Admission to Degree Program

All degree programs in the Department of Geological Sciences are open enrollment. However, special limitations apply for teaching majors.

The Discipline

Geological sciences consist of a number of disciplines aimed at understanding the Earth's origin and development and the natural processes that have operated upon it and within it from the time of formation of the solar system. With the development of remote sensing technology and the exploration of the solar system by spacecraft, geological sciences have become increasingly important for understanding not only the Earth but the Moon, other planets and their moons, and small bodies that orbit the sun.

Understanding the dynamic processes of Earth and other planets is relevant to many societal needs, such as assessment and forecasting of natural hazards, environmental change, and discovery of energy and mineral resources. Some of the diverse disciplines that can be studied in this department include general geology, plate tectonics, geochemistry, geophysics, paleontology, environmental geology, petroleum geology, hydrogeology, paleoclimatology, and planetary geology.

Career Opportunities

Graduates have the opportunity to work both outdoors and in the laboratory, pursuing careers in energy, mineral, and water resources or in environmental evaluation with industry, government, or consulting firms. The substantial preparation in basic sciences and mathematics also leads to a broad spectrum of teaching opportunities. Some scholarship money is available for those who pursue a geological sciences degree as a prelaw track. The most marketable terminal degree in geological sciences is the MS. Starting salaries for this degree are often very competitive with those of other disciplines.

Graduation Requirements

To receive a BYU bachelor's degree a student must complete, in addition to all requirements for a specific major, the following university requirements:

- The university core, consisting of requirements in general and religious education (See the University Core section of this catalog for details. For a complete listing of courses that meet university core requirements, see the current class schedule.)
- A minimum of 30 credit hours in residence
- A minimum of 120 credit hours
- A cumulative GPA of at least 2.0

Undergraduate Programs and Degrees

BS	Earth and Space Science Education
BS	Geology Emphasis (optional): Environmental Geology
Minors	Geology Geology Teaching

Students should see their college advisement center for help or information concerning the undergraduate programs.

Graduate Programs and Degrees

MS Geology

For more information see the BYU 2007–2008 Graduate Catalog.

Global Geology Program

Each year the department provides opportunities for advanced undergraduates and graduate students to examine rocks and geological processes at some premier localities around the world. These one- to two-week field trips allow students to do mentored research projects and develop field expertise rarely available to undergraduate students. Programs that are run every four to five years include:

1. Active volcanism of Hawaii
2. Carbonate formation in Florida and the Bahamas
3. Tectonism and plutonism in the northeast Appalachians.

Trips to more distant localities (e.g., Italy, Great Britain, Alaska) are interspersed with these recurring trips. Scholarships are available that greatly reduce the cost to students.

BS Earth and Space Science Education (83–86 hours*, including licensure hours)

Major Requirements

1. No D credit is allowed in major courses.
2. Complete the following:
 Geol 111, 112, 210, 411.
3. Complete 2 hours of the following:
 Geol 491R (four enrollments).
4. Complete three courses from the following:
 Geol 100, 109, 230, 351, 352, 370, 375, 404, 435, 440, 445, 451, 460, 476, 480.
5. Complete one of the following options:
 Either Chem 105, 106, 107
 Or Chem 111, 112.
6. Complete the following:
 Engl 316.
 Math 119.
 Phil 423.
 Phscs 105, 106, 107, 108, 127, 137.
7. Complete the Professional Education Component:
 - a. Complete the following:
 CPSE 402.
 IP&T 286.
 Sc Ed 276R, 350, 353, 377R, 378, 379.
Note: Fingerprinting and FBI clearance must be completed before enrollment in Sc Ed 377R.
 - b. Complete 12 hours from one of the following:
 Sc Ed 476R, 496R.

*Hours include courses that may fulfill university core requirements.

BS Geology (73–75 hours*)

This basic degree in geology prepares graduates for professional employment in industry or government or for advanced studies in geology, business, or law.

Major Requirements

1. No D credit is allowed in major courses.
2. Complete the following:
 Geol 111, 112, 210, 230, 351, 352, 370, 375, 410.

- Complete 2 hours of the following:
Geol 491R (four enrollments).
- Complete four courses from the following:
Geol 404, 411, 435, 440, 445, 451, 460, 476, 480.
- Complete one of the following options:
Either Chem 105, 106, 107
Or Chem 111, 112.
- Complete the following:
Engl 316.
Math 112, 113.
Phscs 105, 106.
Stat 221.

Possible Specializations

Selecting a broad spectrum of elective courses for the geology BS degree may be best for most students. However, some students may wish to focus on one or more subdisciplines of the geological sciences. The courses listed below may be in addition to those required for the basic major. These are not separate degree tracks, but they may better prepare students for certain career paths or graduate school opportunities.

Petroleum Geology and Geophysics

- Complete the following:
Geol 476, 525.
- Complete two courses from the following:
Geol 440, 480, 521, 560, 561, 571, 574, 575, 580.

Geochemistry and Petrology

Complete at least four of the following elective courses:
Chem 227, 461.
Geol 404, 445, 545, 550, 551, 552, 555.

Vertebrate Paleontology

- Complete at least four of the following elective courses:
Biol 420.
Geol 286, 480, 580, 586.
InBio 380.
PDBio 220.
- Work at least one semester at the Earth Science Museum collecting and preparing fossil vertebrate specimens.

Planetary Geology and Remote Sensing

Complete the following elective courses:
Geog 313, 413.
Geol 109, 411, 440, 490R (planetary seminar).
Phscs 227 (optional 228, 329).

Structure and Tectonics

Complete the following elective courses:
Geol 411, 440, 560, 575.
Me En 250.

*Hours include courses that may fulfill university core requirements.

BS Geology: Environmental Geology Emphasis

(76–79 hours*)

Increasing concern with environmental degradation and natural geologic hazards has led to a demand for geologists who are both well grounded in the fundamentals of the science of geology and specifically prepared to address environmental problems. This degree prepares students for careers either in the environmental services industry or government or for advanced studies.

Major Requirements

- No D credit is allowed in major courses.
- Complete the following:
Geol 111, 112, 210, 230, 351, 352, 370, 375, 404, 410, 435, 445.

- Complete 2 hours of the following:
Geol 491R (four enrollments).
- Complete two courses from the following:
CE En 351.
Geol 411, 440, 535.
PAS 303.
- Complete the following:
Engl 316.
Math 112, 113.
Phscs 105, 106.
Stat 221.
- Complete one of the following options:
Either Chem 105, 106, 107
Or Chem 111, 112.

*Hours include courses that may fulfill university core requirements.

Minor Geology (16 hours)

Minor Requirements

- When all of the geology credit required for a minor is transferred from another school, at least one course in geology must be taken at BYU.
- No D credit is allowed in minor courses.
- Complete the following:
Geol 111, 112.
- Complete 8 hours from the following:
Geol 100, 109, 210, 286, 351, 352, 355, 370, 375, 404, 411, 435, 440, 445, 451, 460, 480.

Minor Geology Teaching (16 hours)

Minor Requirements

- When all of the geology credit required for a minor is transferred from another school, at least one course in geology must be taken at BYU.
- No D credit is allowed in minor courses.
- Complete the following:
Geol 111, 112.
- Complete 8 hours from the following:
Geol 100, 109, 210, 286, 351, 352, 355, 370, 375, 404, 411, 435, 440, 445, 460, 480.

Geological Sciences (Geol)

Undergraduate Courses

100. Dinosaurs. (3:1:2) W

Hands-on examination of vertebrate fossils—especially dinosaurs. For nonscience majors. Field trips.

101. Introduction to Geology. (3:2:1) F, W, Sp, Su Honors also.

Cultural focus on physical and environmental geology for nonscience majors; rocks and minerals. Field trips.

102. Geological Field Studies. (3:6:0) F 1st blk., Su

Outdoor examination of geological processes via afternoon canyon hikes and other hands-on activities. For nonscience majors.

103. Life of the Past. (3:2:1) F, W

Cultural focus on historical geology for nonscience majors; fossils. Field trips.

109. Geology of the Planets. (3:3:0) W For nonscience and science majors.

Origins and distinctive histories of the planets in our solar system as revealed by study of their surface features.

111. Physical Geology. (4:3:2) F, W Prerequisite: Math 112 or concurrent enrollment.

Materials, structure, and surface features of the earth and the geologic processes involved in their development. Field trips and lab studies, use of aerial photos.

112. Historical Geology. (4:3:2) W, Su Prerequisite: Geol 111.

Developmental history of the earth, its landforms, and life forms, emphasizing the North American continent. Field trips and lab studies.

210. Field Studies. (3:0:9) F Prerequisite: Geol 111, 112.

Procedures in observing, collecting, and recording field data concerning properties of rock units. Contact Geological Sciences Department before April 15 for dates of upcoming August trip.

230. Geological Communications. (3:3:0) F, Su Prerequisite: Geol 111; 210 or concurrent enrollment.

Introduction to writing within the discipline and designing and creating publishable geologic maps and illustrations. Tools include ArcGIS, Adobe Illustrator, and Photoshop. Online portfolio initiated.

330. Geology for Engineers. (3:2:2) F, W, Sp

Geological processes and materials bearing on engineering practices. Field trips.

351. Mineralogy. (4:3:4) F Prerequisite: Chem 105 or 111 or concurrent enrollment.

Principles of crystallography and crystal chemistry. Physical, chemical, and crystallographic properties of minerals.

352. Petrology. (3:3:2) W Prerequisite: Geol 210, 351, Chem 105 or 111.

Compositions, fabrics, and field relations of igneous and metamorphic rocks; behavior of rock-forming systems. Field trips.

370. Sedimentology and Stratigraphy. (3:3:3) W Prerequisite: Geol 111, 112.

Erosion; sediment entrainment, transport, and deposition; depositional systems and facies analysis; principles of stratigraphy. Field trips.

375. Structural Geology. (3:3:2) F Prerequisite: Geol 111, 112, 351, 352; Phcs 121 or concurrent enrollment.

Geometric, kinematic, and dynamic analysis of tectonic features. Practical exercises. Using aerial photos. Field trips.

399R. Academic Internship. (1–9:0:0 ea.) F, W, Sp, Su

404. Chemical Processes in the Environment. (3:3:0) F Prerequisite: Geol 111 or 330.

Natural controls on the composition of water; anthropogenic effects on air and water relative to understanding a range of environmental problems.

410. Geological Field Methods. (6:0:46) Sp Prerequisite: Geol 352, 370, 375.

Methods used to observe, collect, and interpret field data in geologic and environmental investigations. Fee.

411. Geomorphology and Geologic Hazards. (3:3:0) W Prerequisite: Geol 111.

Interpretive analysis of landforms and their geologic and environmental significance. Use of aerial photos. Field trips.

430. Senior Thesis. (3:Arr.:0) F Prerequisite: Geol 111, 112, 210, 351, 352, 370, 375.

Faculty-supervised research on a project of limited scope. Project is chosen and completed by the student. Written and oral presentation of findings required.

435. Introduction to Groundwater. (3:3:0) F Prerequisite: Geol 111 or 330; Math 110 or equivalent.

Introduction to the occurrence, movement, and properties of subsurface water; surface and groundwater relationships.

440. Solid Earth Geophysics. (3:3:0) W Prerequisite: Phcs 123.

Physics of the earth, including earthquake seismology. Gravity, seismic, magnetic, electrical, and heat flow properties and methods.

445. Geochemistry. (3:3:0) W Prerequisite: Chem 106, 107; or 112; Geol 352.

Applying elementary chemical principles to understand geologic processes and materials.

451. Optical Mineralogy. (3:2:2) W Prerequisite: Geol 351.

Interaction of light with crystalline material; using petrographic microscope; optical spectrometry.

460. Economic and Resource Geology. (3:2:2) F Prerequisite: Geol 352.

Nature and genesis of metallic and non-metallic mineral deposits, including laboratory study of economic minerals. Field trips.

476. Introduction to Seismic Interpretation. (3:3:0) F Prerequisite: Geol 370, 375.

Fundamental techniques; analyzing seismic reflection data. Reviewing fundamentals of seismic trace and geologic implications. Basic mapping of subsurface structure and stratigraphy.

480. Paleontology. (3:3:2) F Prerequisite: Geol 112.

Distribution, morphology, paleoecology, evolution, and stratigraphic significance of organisms in the geologic record. Field trips.

490R. Short Courses. (1–3:Arr.:0 ea.) On dem. Prerequisite: instructor's consent.

Short, undergraduate-level courses and extended field trips offered on an irregular basis. Fee.

491R. Geology Seminar. (0.5:1:0 ea.) F, W

Seminar on various geologic topics by guest speakers.

492R. Career Pathways Seminar. (0.5:1:0 ea.) W

Seminar on graduate school and career opportunities by guest speakers.

499R. Honors Thesis. (1–6:Arr.:Arr. ea.) F, W, Sp, Su

500-Level Graduate Courses (available to advanced undergraduates)

504. Global Geology Field Studies. (1–3:Arr.:Arr.) On dem.

Prerequisite: any senior-level geology course; instructor's consent.

In-depth study of classic geologic localities, such as Hawaii, the Bahamas, and the Appalachians, preliminary to on-site field study.

521. Borehole Geophysics and Geology. (3:3:0) F alt. yr.

Prerequisite: Phcs 121, 220, Geol 351, 370.

Applied well log analysis, including conventional and new techniques. Subsurface geology and lithology determined from many logs. Determining porosity, permeability, and fluid saturation with hydrology, and hydrocarbon applications.

525. Petroleum Systems Analysis. (4:4:0) F alt. yr. Prerequisite: Geol 370 or equivalent.

Properties of petroleum; exploration methods; generation and migration of hydrocarbons, reservoirs, traps, and seals; sedimentary basin classification; energy resources. Extended field trip required.

530. Geological Communications Laboratory. (3:3:0) F

Prerequisite: instructor's consent; graduate status.

Designing and creating a variety of student-selected geological illustrations emphasizing maps and cross-sections.

535. Contaminant Hydrogeology. (3:3:0) W Prerequisite: Geol 435 or equivalent.

Principles, tools, and applications used to solve heavy metal, organic, and radionuclide groundwater contamination problems. Topics include regulations, mass transport, multiphase flow, transformation, retardation, and attenuation.

545. Isotope Geochemistry. (3:1:4) F alt. yr. Prerequisite: Geol 352 or equivalent.

Use of stable and radioactive isotope systematics in geochronology and investigation of origins of rocks and waters.

550. Environmental Soil Chemistry. (3:3:0) F alt. yr. Prerequisite: Chem 105, 106, 107; or equivalents.

Chemistry of soil systems at macroscopic and microscopic scales, examined from perspective of scientists interested in environmental assessment and remediation.

551. Advanced Mineralogy. (3:2:2) W alt. yr. Prerequisite: Geol 351 or equivalent.

Crystallography, structure, and crystal chemistry of major silicate mineral groups.

552. Igneous Petrology. (3:4:3) Prerequisite: Geol 352 or equivalent.

Origin and evolution of magmas, emphasizing trace element and isotopic compositions and intensive properties as calculated from mineral compositions.

555. Volcanism and Ore Deposits. (1–3:Arr.:Arr.) On dem. Prerequisite: Geol 352 or equivalent.

Field examination of active mafic and silicic volcanism (Hawaii and Yellowstone) and discussion of magmatic volatiles' role in ore deposits.

560. Reflection Seismology Theory. (3:3:0) W alt. yr. Prerequisite: Geol 375, Phcs 121, 123, 220; or equivalents.

Principles, tools, and methods used in seismic reflection geophysics, with exploration, engineering, environmental, and hydrological applications.

561. Applied Exploration Seismology. (3:3:0) F alt yr. Prerequisite: Geol 375, Phcs 121, 123, 220; or equivalents.

Seismic acquisition processing and computer-assisted interpretation, emphasizing field deployment techniques, use of commercial data processing, and visualization software.

565R. Special Topics in Geology. (2–4:Arr.:Arr. ea.) On dem. Prerequisite: instructor's consent.

The following topics may be offered on demand:

- Geology for Teachers
- Ore Deposits
- Solid-Water Interface Chemistry
- X-Ray Crystallography

571. Sedimentology and Ecology of Modern Carbonate Systems. (1–3:Arr.:Arr.) W on dem. Prerequisite: Geol 370 or equivalent.

Field course in the Caribbean emphasizing factors that produce carbonate sediments. Investigation of tidal flat to offshore barrier reef environments and Pleistocene outcrops.

574. Advanced Stratigraphy. (3:3:0) W alt. yr. Prerequisite: Geol 370 or equivalent. Recommended: Geol 480.

Studying the stratigraphic record through modern methods of correlating stratal packages, emphasizing concepts of sequence and seismic stratigraphy, and utilizing methods of chronostratigraphy, biostratigraphy, lithostratigraphy, and absolute dating. Extended field trip required.

575. Advanced Structural Geology. (3:2:3) F alt. yr. Prerequisite: Geol 375, 410; or equivalents.

In-depth discussions of a variety of topics in structural geology, emphasizing current literature and problems.

576. Three-Dimensional Subsurface Mapping and Evaluation. (3:3:0) W Prerequisite: Geol 476 or equivalent.

Advanced interpretation of 3D seismic reflection data. Integrating well and seismic data to interpret complex geologic systems. Implications for understanding hydrocarbon reservoirs.

580. Principles of Paleontology. (3:3:0) W alt. yr. Prerequisite: Geol 480 or equivalent.

Modern approaches to fossil study applied to areas of evolution, paleoecology, and biostratigraphy.

586. Vertebrate Paleontology. (4:3:2) F alt. yr. Prerequisite: instructor's consent.

History of vertebrate fossils. Field trips required. Credit applies in either zoology or geology. Lab studies.

590R. Short Courses. (1–3:3:3 ea.) F, W on dem.

Short graduate-level courses offered on a random basis. Fee.

591R. Seminar. (0.5:1:0 ea.) F, W

Seminar on various geologic topics by guest speakers. Total of 1 credit hour required.

592R. Career Pathways Seminar. (0.5:1:0 ea.) W alt yr.

Seminar on graduate school and career opportunities by guest speakers.

599R. Academic Internship. (1–9:0:0 ea.) F, W, Sp, Su

Graduate Courses

For 600- and 700-level courses, see the BYU 2007–2008 Graduate Catalog.

Geological Sciences Faculty

Professors

- Christiansen, Eric H. (1986) BS, Brigham Young U., 1977; ScM, Brown U., 1978; PhD, Arizona State U., 1981.
- Griffen, Dana Thomas (1979) BS, U.S. Naval Academy, 1965; MS, PhD, Virginia Polytechnic Inst., 1973, 1975.
- Harris, Ronald A. (1998) BS, U. of Oregon, 1982; MS, U. of Alaska, 1986; PhD, U. of London, England, 1989.
- Keith, Jeffrey D. (1990) BS, Brigham Young U., 1977; MS, PhD, U. of Wisconsin, Madison, 1980, 1982.
- Kowallis, Bart J. (1982) BS, Brigham Young U., 1977; MS, PhD, U. of Wisconsin, Madison, 1979, 1981.
- Mayo, Alan L. (1987) BS, MS, San Diego State U., 1970, 1972; PhD, U. of Idaho, 1981.
- McBride, John H. (2002) BS, MS, U. of Arkansas, 1978, 1980; PhD, Cornell U., 1987.
- Morris, Thomas H. (1990) BS, Brigham Young U., 1981; MS, PhD, U. of Wisconsin, Madison, 1985, 1986.
- Nelson, Stephen T. (1997) BS, MS, Brigham Young U., 1984, 1987; PhD, U. of California, Los Angeles, 1991.
- Ritter, Scott M. (1991) BS, MS, Brigham Young U., 1981, 1983; PhD, U. of Wisconsin, Madison, 1986.

Assistant Professors

- Bickmore, Barry (2001) BS, Brigham Young U., 1994; PhD, Virginia Tech., 1999.
- Britt, Brooks B. (2002) BS, MS, Brigham Young U., 1982, 1987; PhD, U. of Calgary, Canada, 1993.
- Radebaugh, Jani (2006) BS, MS, Brigham Young U., 1993, 1999; PhD, U. of Arizona, 2005.

Research Professors

- Dorais, Michael J. (2000) BS, Brigham Young U., 1980; MS, U. of Oregon, 1983; PhD, U. of Georgia, 1987.
- Tingey, David G. (1990) BS, MS, Brigham Young U., 1983, 1989.

Adjunct Faculty

- Nixon, R. Paul (1989) BS, MS, U. of Utah, 1955, 1955; PhD, Brigham Young U., 1972.

Assistant Teaching Professor

- Skinner, H. Randal (2003) BS, MS, Brigham Young U., 1992, 1996.

Emeriti

- Baer, James L. (1969) BS, Ohio State U., 1957; MS, PhD, Brigham Young U., 1962, 1968.
- Best, Myron G. (1965) BS, U. of Utah, 1957; PhD, U. of California, Berkeley, 1961.
- Brimhall, Willis H. (1955) BS, Brigham Young U., 1949; MS, U. of Arizona, 1951; BES, Brigham Young U., 1960; PhD, Rice U., 1966.
- Bullock, Kenneth C. (1943) BS, MA, Brigham Young U., 1940, 1942; PhD, U. of Wisconsin, Madison, 1949.
- Hamblin, Wm. Kenneth (1962) BS, MS, Brigham Young U., 1953, 1954; PhD, U. of Michigan, 1958.

Germanic and Slavic Languages

Hintze, Lehi F. (1955) BA, U. of Utah, 1941; MA, PhD, Columbia U., 1949, 1951.
Miller, Wade E. (1971) AA, El Camino Coll., 1957; BS, Brigham Young U., 1960; MS, U. of Arizona, 1963; PhD, U. of California, Berkeley, 1968.
Petersen, Morris S. (1966) BS, MS, Brigham Young U., 1955, 1956; PhD, U. of Iowa, 1962.
Phillips, Wm. Revell (1957) BS, MS, PhD, U. of Utah, 1950, 1951, 1954.
Rigby, J. Keith (1953) BS, MS, Brigham Young U., 1948, 1949; PhD, Columbia U., 1952.

Germanic and Slavic Languages

David K. Hart, Chair
3112 JFSB, (801) 422-4923

College of Humanities Advisement Center
1175 JFSB, (801) 422-4789

Admission to Degree Program

All degree programs in the Department of Germanic and Slavic Languages are open enrollment. However, special limitations apply for teaching majors.

The Discipline

Students of foreign language and literature develop fluency in another language as well as sensitivity to their own language and cultural heritage, to the contributions and diversity of other peoples, and to the advantages of an international perspective.

Career Opportunities

Experience with the intellectual, artistic, and spiritual expressions of other cultures and of their own culture helps students qualify for advanced study at graduate and professional schools, especially in linguistics, literature, language teaching methodology, library science, humanities, business, law, and medicine. Those who accept employment on completion of the BA degree frequently serve in international business, in education, or in a government agency.

General Information

The Department of Germanic and Slavic Languages strongly recommends that StDev 317, a 1-credit-hour course, be taken at the end of the sophomore year or the beginning of the junior year. Because liberal arts degrees provide preparation in a variety of useful fields rather than a single career track, this course is recommended to help liberal arts students focus on specific educational and occupational goals and to identify the career options or educational opportunities available to them. The course will introduce them to the resources needed for accessing information about graduate schools, internships, careers, and career development. Students will learn basic employment strategies, including the steps necessary for obtaining employment related to their own specialty.

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- A minimum of 30 credit hours in residence
- A minimum of 120 credit hours
- A cumulative GPA of at least 2.0

Undergraduate Programs and Degrees

BA German
Emphases:
Linguistics
Literature
BA German Teaching
BA Russian
Minors German
German Teaching
Russian
Russian Teaching

Students should see their college advisement center for help or information concerning the undergraduate programs.